TO ALL WHOM IT MAY CONCERN:

Be it known that I, **John K. Collings, III,** having a post office address and a residence address at 2910-A Cole Court, Norcross, Georgia 30071, a citizen of U.S.A., have invented new and useful improvements in a

EVENT NOTIFICATION SYSTEM

for which the following is a specification.

EVENT NOTIFICATION SYSTEM

CROSS REFERENCE TO A PROVISIONAL APPLICATION

This patent application claims priority on Provisional Application Serial Number 60/213,372, filed on June 23, 2000, the entirety of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to communications systems and, more specifically, to systems that transmit notifications using non-automatically receipt confirmed technology.

2. Description of the Prior Art

Existing event notification systems alert an operator at a central office to the occurrence of events. Such events could, for example, take the form of alarms at remote facilities. The operator, once alerted to the event, evaluates the event and, if indicated, dispatches a technician to the site of the event. For example, in a water utility system, an event might include a high wet well alarm at a pumping station. The notification system alerts a central utility office of the alarm. An operator responds to the alarm by directing a technician via telephone to the pumping station, along with providing information necessary for the technician to investigate the alarm.

An autodialer notification system involves a device disposed at a remote facility that is connected to a dedicated telephone line. If an event is sensed, the autodialer device typically dials the telephone number of the central office and reports the event to an operator. An autodialer system has the disadvantage of requiring the user to bear the expense of a dedicated telephone line. A dedicated radio notification system works like an autodialer notification system, except that it uses a dedicated radio system to

perform the communication function. Typical dedicated radio systems also tend to be expensive. Furthermore, such systems do not include an inherent mechanism for verifying that the technician has accepted responsibility for an event or that the technician has arrived at the site of the event.

Graphical event reporting systems typically include a display, such as a computer screen or a board with embedded lights, that presents a map or other image depicting potential locations of events (which are fixed locations) and an indication of the occurrence of events as they occur. Such systems have the disadvantage of not being able to display simultaneously the location of mobile assets (*e.g.*, technicians) that can respond to the events.

One application of an event reporting system reports rainfall. Such a system uses a "tipping bucket" that measures rainfall and that is coupled to a prior art reporting system to notify a central office of heavy rainfall episodes. Given that rain frequently falls over a wide geographic area having multiple rainfall reporting systems dispersed throughout the area, existing systems may cause multiple alarms to be sent to the central office to report a single episode of heavy rain.

Therefore, there is a need for an event notification system that automatically verifies a response to an event, that is compatible with existing event notification systems, that displays the location of both events and mobile assets assigned to respond to events, and that is capable of accepting a single response for multiple linked alarms.

SUMMARY OF THE INVENTION

The disadvantages of the prior art are overcome by the present invention which, in one aspect, is a method of transmitting an event notification in which a first data packet that includes a first event code is transmitted to a first individual via a not-automatically receipt confirmed communication. The first event code corresponds to a first event. Upon receiving a response communication from the first individual, the

first individual is requested to respond with the first event code. If the first individual responds by transmitting the first event code, then the first event is identified from the first event code. Instructions relating to the first event are transmitted to the first individual.

In another aspect, the invention is a method of transmitting an event notification in which an event indication, indicating an event condition, is received from a remote station. At least one individual is notified of the event upon expiration of a preselected period.

In another aspect, the invention is a method of transmitting an event notification in which a notification of an event is automatically transmitted from a central event notification center to at least one individual. An indication of acceptance of responsibility for the event is received from the individual at the central event notification center. Upon completion of the receiving step, a central database is updated to indicate that the event has been responded to.

In another aspect, the invention is a method of displaying status of notifications in which a map is displayed on a computer screen and at least one first icon, corresponding to a location of a stationary asset that is subject to the occurrence of events, is displayed on the map. The icon is altered to signify the occurrence of a first event if the first event occurs at the stationary asset. An indication of a current location of a mobile asset assigned to respond to the event is received. At least one second icon, corresponding to a current location of the mobile asset, is displayed on the map

In yet another aspect, the invention is method of delivering event notification data to a proprietary network used by a local facility in which event notification data is received from a local reporting device. The event notification is received at a central notification processing center of a multi-user notification network. The event notification data is converted from a first data format, characteristic of the multi-user notification network, into a second data format, characteristic of a proprietary

network. The event notification data, in the second data format, is transmitted to a local facility.

In yet another aspect, the invention is a method of monitoring rainfall in which rainfall is sensed with a rainfall sensor at a selected location. Rainfall data indicating an accumulated rainfall amount, determined as a result of the sensing step, is periodically transmitted to a central processing center using a not-automatically receipt confirmed communication protocol device and the rainfall data is provided to a selected local facility.

In yet another aspect, the invention is a device for accepting a response to a notification from an individual at a selected location that includes a personal identification apparatus disposed at the selected location. The personal identification apparatus is capable of identifying an individual and is capable of verifying that the individual is at the selected location. A wireless communication apparatus, responsive to the personal identification apparatus, transmits to a central notification processing center an indication that the individual is at the selected location.

These and other aspects of the invention will become apparent from the following description of the preferred embodiments taken in conjunction with the following drawings. As would be obvious to one skilled in the art, many variations and modifications of the invention may be effected without departing from the spirit and scope of the novel concepts of the disclosure.

BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWINGS

FIG. 1 is a schematic diagram illustrating one aspect of the invention.

FIG. 2 is a schematic diagram of a transmitting device according to one aspect of the invention.

FIG. 3A is a flowchart illustrating one embodiment of a method according to the invention.

FIG. 3B is a flowchart illustrating a response routine employed with the flowchart of FIG. 3A.

FIG. 3C is a flowchart illustrating a response illustrating a routine for handling multiple alarms.

FIG. 4 is one exemplary output screen accessible by a user of the invention.

FIG. 5 is a schematic diagram of a hybrid system according to one aspect of the invention.

FIG. 6 is a flowchart illustrating one embodiment of a method for reporting rainfall according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

A preferred embodiment of the invention is now described in detail. Referring to the drawings, like numbers indicate like parts throughout the views. As used in the description herein and throughout the claims, the following terms take the meanings explicitly associated herein, unless the context clearly dictates otherwise: the meaning of "a," "an," and "the" includes plural reference, the meaning of "in" includes "in" and "on." Also, as used herein, "global computer network" includes the Internet. "Not-automatically receipt confirmed" communications are communications in which the technology employed does not automatically provide the sender with a confirmation of receipt by the receiver of a communication.

As shown in FIG. 1, in one embodiment of the invention **100**, a plurality of notification and identification devices **110** are disposed at a plurality of remote sites **102**. Examples of remote sites include, but are not limited to: pumping stations

operated by water utilities, communication switching stations, remote power distribution stations, and rainfall measuring points. The notification and identification devices **110** each communicate with a wireless communications link **104**. Many different types of communications link systems could be employed with the invention without departing from its scope, a few illustrative examples of which include: the Cell Digital Packet Data (CDPD) system; the Wireless Data Network, available from Bell South; and the National 2-way paging system available from Page Net.

As shown in FIG. 2, a typical notification and identification device **210** is powered by a voltage source **220**, such as a power supply backed up by a battery, and includes an electronic controller **212**, such as a microprocessor, that is responsive to one or more event signals **202** (*i.e.*, alarm signals) received from the local site. The event signals are received from devices having automatic alarms and automatic measuring capability (*e.g.*, rainfall sensors such as a tipping bucket-type sensors). The controller **212** communicates with a wireless communication device **214** so that when an event is sensed at the local site, the controller **212** causes a signal indicative of the type and location of the event to be sent to the communications link. A personal identification apparatus **216** is in communication with the controller **212** and is capable identifying and individual. In one embodiment, the personal identification apparatus **216** comprises an identification service key reader **218**, such as I Button Technology, available from Dallas Semiconductor Corporation. With an identification key reader **218**, each individual who would respond to an event is issued an electronic identification key that generates a unique signal. To indicate arrival at a location of an event, the individual passes the identification key close to the key reader **218**. The key reader **218** senses the unique signal generated by identification key and transmits a corresponding electrical signal to the controller **212**. Other methods of personal identification within the scope of the invention include: bar code scanning (employing a bar code reader disposed at the identification device **210** and a bar coded tag issued to the individual), magnetic stripe reading (employing a magnetic stripe reader and a card with a magnetic stripe), a biometric data reader (such as a finger print reader), or any of the many other technologies for identifying personnel at a specific location.

Returning to FIG. 1, the communications link **104** communicates with a central notification processing center **120**, which is also in communication with a plurality of local facilities **122** via the global computer network **106** (*e.g.*, the Internet), or other type of wide area network (*e.g.*, a telephone system). Each local facility is typically owned by a subscribing organization and the central notification processing center **120** could be a facility having area-wide (including nation-wide or even world-wide) responsibility for a plurality of notification and identification devices **110**, groups of which are owned by several different subscribing organizations that are dispersed over the entire area of responsibility.

The central notification processing center **120** is also in communication, via the communications link **104**, with a plurality of employees **112** of the subscribing organizations, or other responsible personnel. Such employees **112** would be assigned by the subscribing organizations to respond to the various events. For example, if one of the subscribing organizations was a water utility, the organization could assign electrical technicians to respond to electrical system alarms, could assign plumbers to respond to piping system alarms and could assign security personnel to respond to intruder alarms. The assigned employees **112** could also be in communication with a locating system **108** to provide location data to the central notification processing center **120**.

A shown in FIG. 3A, the system operates in a wait loop **302** until an alarm, or other event notification, is received from a remote site. Upon receipt of an event notification, the system determines the location and nature of the event **304**. Typically, the notification device transmits a code to the central notification processing center that identifies both the location and the nature of the event. Thus, to perform the determining step **304**, the central notification processing center indexes a look-up table with the identifying code.

The system activates a scheduler routine, which accesses a data base **306** to determine the personnel currently on duty who may respond to the event. The available personnel may be further filtered **308** based on other criteria, such as who is

already assigned to other tasks, who is best qualified to respond, *etc*. The selection criteria may include: who of the plurality of individuals is currently on duty, who of the plurality of individuals is closest to a location of the event, who of the plurality of individuals is currently not assigned to another event, and who of the plurality of individuals is most capable of responding to the event. For example, if a pumping station were to report an ac power failure, then the system would notify a technician from power utility. If the pumping station were to report a high wet well, then the system would notify a custodian with a pump. If the pumping station were to report a pump not starting, then the system may notify a pump technician. If the pumping station were to report a intrusion, then the system would notify a security office or the police.

The system may also determine who of the qualified candidates is the closest to the event **310** and generates an event code that is assigned to the closest potential responder **312**. The event code is then transmitted to the responder **314** via a not-automatically receipt confirmed transmission medium. Examples of such media include pagers, wireless telephones and even radio broadcasts. The responder is instructed to call the central notification processing center, enter the event code and follow a procedure to indicate acceptance of responsibility for the first event, such as depressing a preselected button on a telephone handset. The responder may also be given a set of instructions as to how to respond to the event and directions to the location of the event. The system may also execute a responder backup routine, in which a secondary responder is chosen **316** from the list of available and qualified responders, a second event code is generated and assigned to the secondary responder **318**. The second event code is transmitted to the secondary responder **320** and the system exits **330a** to a receive response routine.

After entry **330b** to the receive response routine, as shown in FIG. 3B, the system awaits a response **332** from the individuals assigned to respond to the event. As part of the response process, the system requires the person responding to enter the event code. If preselected amount of time expires prior to receipt of the acknowledgment **352**, then control returns to the await response loop **332**. Once a

response is received, the system accesses **334** a look-up table indexed on the event code included in the response. The system then determines **336** if the event code corresponds to the event code transmitted to the first technician. If so, the system transmits information **338**, such as directions and an identification of the event, *etc.*, to the first technician. The caller could also be identified by a caller identification packet received from the telephone system. The system then requests **340** that the first technician accept responsibility for the event. If an acknowledgment is received **342**, indicating that the first technician accepts responsibility for the event, the system requests that the technician accept responsibility for all related events **344** (if any), such as related pending events or related subsequent events. If the technician refuses to accept responsibility for related events, the system sends notifications **350** for subsequent and pending related alarms and records the acceptance **346** of the first event by the first technician. If the first technician accepts subsequent events, then the system records the acceptance **346** of the event and instructs **348** the second technician not to respond to the event. At this point, control returns **330a** to the main routine.

While one way of receiving acknowledgment for an event is through the call-in procedure described above, other ways of acknowledging events may also be employed. For example, returning to FIG. 1, if a response vehicle **112** corresponding to the assigned technician includes a locator employing GPS **108** and if transmissions from the response vehicle **112** indicate that the response vehicle **112** is within a predetermined distance from the location of the event for a predetermined amount of time, then the central notification processing center **120** may be programmed to assume that the assigned technician has responded to the event. The personal locator apparatus may be programmed to enter an inactive mode once the location of the individual is within the preselected distance from the event, thereby reducing wear on the battery of the service vehicle **112**. Similarly, referring to FIG. 2, if the assigned technician activates the personal key reader **218** at the location of the event, then the system may be programmed to assume that the assigned technician has responded. Automatic response acknowledgments, as described above, may be useful when the technician has no other means of contacting the central notification processing center

120, such as when the technician is notified of an event by a pager, and in cases where technicians forget to call in to respond to event notifications.

Returning to FIG. 3, if the result of decision **336** is that the event code does not correspond to the first technician, then the system determines if the code corresponds to the second technician **356**. If not, then the event code is either spurious or garbled and control returns **330a** to the main routine. It the event code does correspond to the second technician then the system transmits information **358**, such as directions and an identification of the event, *etc.*, to the second technician. The system then requests **360** that the first technician accept responsibility for the event. If an acknowledgment is received **362**, indicating that the second technician accepts responsibility for the event, the system requests that the technician accept responsibility for all related events **370** (if any). If the second technician refuses to accept responsibility for related events, the system sends notifications **372** for subsequent related alarms and records the acceptance **364** of the event by the second technician. If the technician accepts subsequent events, then the system records the acceptance **364** of the event and instructs **366** the first technician not to respond to the event and control returns **330a** to the main routine.

In an alternative embodiment, the system could send a single event code to a plurality of potential responders and then identify the person accepting responsibility for the event either at the time the person calls into the central facility, or at the time the person actually arrives at the site of the event. In this embodiment, upon receipt of a first response, the system may send out subsequent notifications to the potential responders indicating that a response to the event has been received. The system would also record the first response at the central event notification center.

By recording the events and acceptance of responsibility therefore, the system is able to generate useful management reports. Such reports could include reports relating to response time of the technicians, average workload and the types of events that occur.

The system may also programmed so as to able to report operating parameters to the responder. For example, in a case where the notification device were monitoring a pumping station, the notification device could transmit a recent pump run time history upon receipt of a high wet well alarm. The central notification server could then forward this information to the responding technician, who could use the information to determine whether the cause of the alarm was a faulty pump or some other cause.

As shown in FIG. 3C, a routine used to group several related alarms (or other reportable events) and to ignore spurious alarms may be employed to prevent a responder from receiving many different related alarms or spurious alarms. The routine starts with waiting for an alarm to be received **380**. Upon receipt of an alarm, the system will start a timer **382** that counts a preselected period of time. The preselected period should correspond to the greater of the expected amount of time from completion of the receiving step **380** until a restore signal would be transmitted from the station transmitting the alarm or the expected amount of time from completion of the receiving step **380** until all related alarms were received. The system checks to see if the preselected period has expired **384** and, if not, it will check to see if a restore indication (received from the alarm reporting device) has been received **386**. Such a restore indication would indicate that the alarm condition has gone away. If a restore has been received, the system is reset and control passes to decision **380**. Otherwise, the system checks to see if a new related alarm has been received **388**. Related alarms are alarms that occur as a result of a common occurrence. For example, an area-wide power failure could cause several geographically close pumps to fail simultaneously. Similarly, a power failure at a pumping station could first trigger an AC power failure alarm. The loss of AC power could cause a high wet well, which would trigger a high wet well alarm. A high wet well could trigger a pump failure alarm and then a pressure leak failure alarm. These cascading alarms would typically occur within the predetermined period from the AC failure alarm. Each time a new related alarm is received during the predetermined period, the system records the new alarm **390** and checks if the predetermine period has expired yet **384**. Once it

has expired, the system may process all alarms **392** by grouping the related alarms and by sending out a group notification of the related alarms.

As will be readily appreciated by those of skill in the art of software design, the above example is but one of many ways of embodying the invention. Thus, the scope of the invention is not to be limited by the specific method shown in FIGS. 3A-C.

The system could also include a routine that automatically waits for a responder when calling the responder to report an event. For example, the central notification center could call a responder and state "This is XYZ Corp. calling for John Doe, if John Doe is available, please press 1, if John Doe is not available, please press 9, if you would like me to wait while John Doe becomes available, please press 5." If the person at the receiving end presses 5, indicating that the responder is expected to pick up the telephone shortly, the system will then play a wait message, such as "I am waiting for John Doe. When John Doe is available, please press 1."

As shown in FIG. 4, the system presents a display **400**, via the global computer network, to the local facility (**122** in FIG. 1). The display includes a map **410** that shows the location of fixed assets where event notification devices are disposed and the location of mobile assets capable of responding to the events. The fixed assets may be simply depicted as dots **420a-c** on the map **410**, or as graphical icons representing the type of fixed asset. For example, icon **422** represents a pumping station, whereas icon **430** represents a rain gauge. Identifying text **424** may accompany the graphics icons **422** or the dots **420a-c**, or both. A preselected color or texture scheme can be associated with the representations of the fixed assets to convey information relating to events. For example, dots **420a** could be colored green to indicate no reported events, dots **420b** could be colored red to indicate alarms, and dots **420c** could be colored yellow to indicate warning-type events. Flashing dots and non-flashing dots could also be displayed to indicate relative urgency of an event. Furthermore, a pop-up providing additional information **434** about an event may be displayed upon pointing a cursor **432** at the graphical display of the fixed asset.

The map **410** also shows the current location of mobile assets that may be available to respond to events. The mobile assets, such as service trucks, may be represented with graphical icons **426** that resemble the type of mobile asset. Information specifically identifying the mobile asset (*e.g.*, a truck number) may also be included in the icon. The location of the mobile asset may be determined in one of several ways. For example, the mobile asset may include an auto vehicle locating device or other type of personal locating device, such as a Global Positioning Satellite receiver, that periodically transmits its position to the central notification processing center. The personal locating device could also include a cell phone locator, a net-based locator device, or one of many other personal locating devices known to the art. The current location could also be determined from reports radioed in by the technician driving the service truck **426**. The system could also provide a mechanism for switching back and forth between a map showing fixed assets and a corresponding map showing mobile assets.

Once the system verifies that the technician has arrived at the location of the event, the system is informed of the arrival and may activate a service mode that causes a preselected set of subsequent events occurring at the location of the event to be ignored. This may be useful, for example, when a technician must turn off power to a system in order to repair mechanical aspects of the system. The turning off of power might trigger a power failure alarm and an intrusion alarm. The service mode would prevent such alarms from being further processed.

As shown in FIG. 5, some users may wish to phase in use of an event notification system according to the invention with an existing user-specific event notification system. Typically, the present system includes a plurality of local facilities **522a** and **522x-z**, each of which could belong to a different entity, that communicate with the central notification processing center **520** via the global computer network **506**. One of the local facilities **522a** would cover a local area of operation **502**, and would communicate with a plurality of new event notification devices **510** according to the invention and a private network of prior art notification devices **512** (*e.g.*, auto dial or dedicated radio devices). In such a case, the central notification processing center

520 could translate the data received from the new devices **510** into the format presented by the prior art devices **512** (which are part of a proprietary network, including a local network) and emulate the screen presentations generated by the prior art systems and present them to the local facility **522a**. The local facility **522a** could also transmit the data from the prior art notification devices **512** to the central notification processing center **520** via the global computer network **506**. The central notification processing center **520** could then integrate the data so received with the data received from the new notification devices **510** and present a unified display to the local facility **522a** in the format of the local facility's choice.

Rainfall data may be processed, as shown in FIG. 6, by the central notification processing center. In one illustrative embodiment, a computer at the central notification processing center starts a timer **610** that counts down a preselected amount of time (*e.g.*, one hour). During that time, the central notification processing center periodically receives rainfall data **612** from at least one rainfall sensor. The amount of rainfall is added to an accumulator, or other memory location, and a test **616** is performed to determine if the value stored in the accumulator is greater than a predetermined threshold value (*e.g.*, one-tenth of one inch). If the accumulator value has not exceeded the threshold value, then a test **618** is performed to determine if the timer has timed out. If not, then the next packet of rainfall data is received **612**. Otherwise, a normal data report is transmitted **620** to the local facility, the accumulator is reset **622**, the timer is reset **610** and the process repeats itself.

If test **616** indicates that the accumulated rainfall for a given period exceeds the threshold, then an urgent event notification is sent **624** both to a preselected individual or individuals responsible for such an event and to the local facility. The event notification and response procedure used could be according to the procedure outlined above, with respect to FIGS. 3A-C. Given that heavy rain could fall over an extensive geographic area, triggering several events relating to several corresponding rainfall sensors, the system could allow a technician to accept responsibility for several related heavy rainfall events. If the system determines **626** that the technician does not accept responsibility for multiple events, then the accumulator is reset **622** and the process is

repeated. If the technician accepts responsibility for multiple events, then the system disables **628** reporting of subsequent related rainfall events during a preselected period of time, the accumulator is then reset **622** and control passes to the restarting of the timing circuit **610**.

In one application of the invention, the system can be used to generate preventative maintenance logs, watchman visit logs and other audit trails. The individual's personal identification data is read by the personal identification apparatus at the preselected location. This information is transmitted to the central processing center via a wireless communication channel, along with a timestamp and a location identifier. The information received at the central processing center is stored and a visit report is generated from the stored information.

The above described embodiments are given as illustrative examples only. It will be readily appreciated that many deviations may be made from the specific embodiments disclosed in this specification without departing from the invention. Accordingly, the scope of the invention is to be determined by the claims below rather than being limited to the specifically described embodiments above.